Urban Green Spaces As Promoters of Healthy Living: Evidence From Putrajaya, Malaysia

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Abstract

Open spaces have a significant positive impact on the overall well-being of the residents of urban areas and the influence on the use of recreational facilities due to the extent of the residents' engagement with these infrastructures and active lifestyles. The effectiveness of using these spaces on the well-being of residents is on their relative quality, quantity, and accessibility. Putrajaya houses 350,000 residents; about 4,931 (37%) of the total landmass was designated as open space to have a balanced city. Four of the twenty open spaces were purposeful selected based on their respective quality and services for the harmonious development of Putrajaya. A convenient sampling technique (non-probability) determines the respondents in each designated open space. This research used the survey data collection method to collect the primary data, using a cross-sectional approach. Pearson product-moment correlation analysis was used to determine the extent and direction of the relationship between open space attributes and health promotion. And multiple regression analysis (entered method) was adopted to predict the health promotion' of residents who visited the provided open spaces based on their respective quality, quantity, and accessibility. The results reveal that the areas' sizes, existing facilities, and greenness are the predominant influencing incentives that attract patronage by both local and international users. Meanwhile, when designing open space to promote the health status of respective users, effort must be toward providing high aesthetic quality in sufficient quantity and size, as indicated in this study.

1 Introduction

Health is defined by the World Health Organization (WHO) as not just the absence of diseases but as a state of the complete state of mental, physical, and psychological well-being. Therefore, such approaches, actions, and policies geared towards influencing and maintaining physical and psychological well-being can readily be one of the enablers of health promotion. An optimal urban design can promote the health status of residents on the one hand by providing social services close to the residents (Badland *et al.*, 2014), and on the other, integrating open spaces in densely populated built areas to enhance and promote active living (Giles-Corti *et al.*, 2013). Urban planning to improve residents' health status is traceable to the post-war period (1850-1900). Most American and European cities experienced rapid industrialization characterized by pathogenic urban degradation (Corburn, 2007). Overcrowding and pollution in urban areas led to increased contagious diseases. Thus, creating urban parks is considered an enabler for mitigating the consequences of urban degradation and offering the cities some breathing spaces (Corburn, 2007).

The 21st-century cities design and development around the globe contributed to the occurrences and spread of diseases. They manifested by the apparent urban growth led by unsustainable use of land, leading to vulnerable nurture of sedentary lifestyle in the cities characterized by relatively inadequate open spaces necessary for promoting active living. This development pattern reduces the number of available urban green spaces, thus, affecting the quality of urban life (Ewing *et al.*, 2014). But, ultimately, open spaces are resources for promoting recreational activities which encourage active living (Jim & Chen, 2006), and hence, systematic, optimal, and sustainable provision of open spaces in urban areas

which can positively influence the health status of its residents. They drive a healthy lifestyle, such as recreational facilities for self-fulfillment, relief from stressful conditions, and a departure from a sedentary lifestyle. Therefore, the need for the provision of decently designed and managed open spaces is more than a prerequisite if a healthy urban lifestyle is to be improved and maintained.

The sprawling system of urban development, which is considered lower density, single land use pattern, limited open spaces, and poor network connectivity, harms the healthy well-being of urban residents (Badland *et al.*, 2014). A compact system efficiently integrated with sufficient open spaces with multiple land uses represents sustainability attributes. Therefore, urban sprawl and compact system of development are the two urban design techniques that provoke much academic and political argument (Jabareen, 2006). Supporters of each system based their opinion on the context of their country's peculiar characteristics (Burge *et al.*, 2014). Both politicians and academics presently contested a sprawling system (Goetz, 2013). It was related to traffic accidents, air and water pollution risk, and physical inactivity (Ewing, Schieber, & Zegeer, 2003). Feng *et al.* (2010) reviewed several pieces of literature on built environment and obesity. Their result has demonstrated the effort to understand the positive relationship between inactivity and the built environment. Thus, this study explores the relationship between open space attributes (quality, quantity, and accessibility) and health promotion resulting from their visitation.

Some countries (for instance, Australia) have already recognized the importance of collaborating between health agencies and town planners. Planning Institutes of Australia (PIA), in its 2010 report, highlighted how collaboration between two agencies reduced health expenditures (Planning Institute of Australia, 2010). Meanwhile, preventive measures are more effective and cost-efficient than curative Medicare. Urban planning, therefore, is one of the leading mechanisms that can enhance the health status of urban residents by providing open spaces within the urban fabric, which stimulate green exercise and hence reduce the incidence of obesity resulting from inactivity.

2 Material And Methods

A detailed closed-ended questionnaire captured the respondents' views on the provided open space they visited. Open spaces are described based on their respective quality, quantity supplied (both size and number), and accessibility by the general public. The questionnaire also elicits the benefit derived from visiting open spaces by the residents. The questionnaire uses a bilingual strategy to understand its contents clearly.

2.1 Study area

Putrajaya is 25km south of Kuala Lumpur, 20km to the North of Kuala Lumpur International Airport (KLIA), and within 50km of the Malaysian Super Corridor (MSC). The city lies on latitude N 20 55'34.8996" and on longitude E 101 04'47.202". The city of Putrajaya is to house 350,000 residents when completed, and the present population is 72,413 (Federal Department of Statistics, Malaysia, 2010).

The city of Putrajaya is a Federal Capital Territory designed with much environmental consideration. It can become a model for other cities and play a pioneering role in Asian cities. The total landmass of Putrajaya is about 4931 hectares, of which one-third (37%) was green spaces, including gardens and parks. Putrajaya Lake collects surface runoff water to control flooding in the planned city and moderate temperature for a liveable environment. The designed open spaces provide recreational function and ecological service (Moser, 2010). Putrajaya Lake serves as a check on moderating harsh temperature, thereby stimulating green exercise. It serves as a corridor that connects different open spaces to ensure the conservation of both flora and fauna in the study area (see Figure 1). It provides the residence with an opportunity to engage in recreational activities. The lake covered about 197.20 hectares, with planted regions covering approximately 77.70 hectares and an open water body covering 76.80 hectares.

2.2 Units of Analysis

The researchers made a purposeful selection of open spaces based on their respective quality and services for the harmonious development of Putrajaya. This method is the most viable option because Putrajaya has been a city designed in neighborhood concept, consisting of twenty different precincts with neighborhood parks in every individual precinct. Thus, the arrangement of the precincts does not conform to any systematic categorization that would permit a random sampling technique. Therefore, individuals were selected as respondents using the non-probability method (Convenient Sampling Technique). This technique implies that respondents are chosen based on their availability. Essentially, Putrajaya Lake, Taman Putra Perdana, Taman Saujana Hijau, and Taman Botani were selected for the study.

Taman Putra Perdana is in precinct one in Putrajaya city; the park is an intermediary between the natural domains to the North and the Government offices and Commercial domains to the South and Eastern part, respectively. The arrangement would reduce the impact of commercial and administrative activities that would be detrimental to the ecosystem in the northern site. Taman Putra Perdana is about 64 hectares as such is considered large enough to accommodate various open space users, and is well integrated within the urban fabric. Efficient design and combination of available water bodies with greeneries provide a relaxed atmosphere for park visitors.

At Precinct 11, Putrajaya, Taman Saujana Hijau is a public park with lush greenery and pine trees decorating hilly terrain that covered 41 hectares. This setting has several benefits in controlling erosion of the hilly side, limiting residential growth, and serving as a recreational center to the residents of Precinct 11. These qualities present a unique view that attracts various categories of open space users. A park is an ideal place for family outings and recreation activities.

Taman Botani is in the northern part of Precinct 1 of Putrajaya. The land area covered by the park extends to about 92 hectares which is the biggest of its kind in Malaysia. The park consisted of flowering, ornamental plants, preservation, and scientific research. Taman Botani contained about 700 variety of plant for research, with lush exotic flowers that enhances the park's quality and attractiveness for the visitors.

2.3 Sample Size and Sampling Technique

The idea of sampling is to collect some numbers from the whole population to make inferences about the people. Sample choosing must be an accurate representation of the entire population. Putrajaya has about 72,000 populations (Putrajaya holdings, 2013). The sample used was 400 based on (Krejcie & Morgan, 1970) table of sample size that gives 382 as the sample size for 75,000 people, while the researchers use the formula given by the same authors as $s = \frac{X^2NP(1-P)}{d^2(N-1) + X^2P(1-P)}$ with a population of 72,000 that generated the answer to be 386, with a difference of 4 as given by the table on the population size of 75,000. Three hundred and eighty-six (386) respondents participated in the study, drawn from 75000 residents of Putrajaya using a convenient sampling technique. Three hundred and seventy-one (371) valid questionnaires were then used for the analysis. The research uses a survey method in collecting the primary data, a technique judged to be the most appropriate in this circumstance (Ghosh & Żądło, 2014). The data contained in this research is cross-sectional, implying that the data was collected simultaneously (Brick & Williams, 2012). The duration of data collection lasts for forty days starting from 15th January, 2014-1st March 2014.

2.4 Qualitative Rating Criteria of Open Spaces

The researchers rated the four selected Open spaces with the sole purpose of providing a critical overview that would permit replication of the procedure as the case with every subjective analysis. Each of the three attributes used in the study was rated equally. The rating ranges from "Good" denoted as 3, "average" with a score of 2, and limited with a score of 1 (Danjaji & Ariffin, 2017). The quality attribute rating considers the aesthetic quality and design strategy used in developing the open space. Any urban green space with a well-integrated component of blue and green facilities with some attractive features regarded as the enabler of visitation will gain a score of 3 points. The quantity of open space is by calculation of 'range' – that's open space selected with highest area coverage minus the one with the lowest area coverage divided by two - a mean score of the two extreme values. Accessibility is by locational factors and available connectivity linking a given open space.

2.5 Reliability

The Cronbach alpha provides a coefficient of inter-item correlations, that is, the correlation of each item with the sum of all the other relevant articles, and is helpful for multi-item scales. Thus, it signifies that all the constructs provided in the questionnaire containing five or nine items could be considered suitable candidates for measuring inter-item correlation based on alpha values. The alpha coefficient ranges in value from the highest score of one (1) to the lowest score of zero (0); these are values obtained in predicting construct reliability in a given questionnaire instrument. Cortina (1993) has indicated the value of 0.7 as an acceptable reliability coefficient; meanwhile, all the values obtained in this study have a good reliability coefficient.

2.6 Statistical Analysis

The variables used in the study are latent variables that are not directly observed but influences statistical analysis. The constructs used are quality, quantity, and accessibility. Each of these variables contained several questions. The series of questions are summed-up before analysis. Thus, average values represent the construct used in the study. The research undertakes Pearson product-moment correlation analysis to determine the relationship and direction between the attributes of open space (quality of the chosen open space, its quantity, and accessibility) and health promotion. The analysis determines the relationship between each component of the urban green space attributes and health promotion benefits derived from visits. Pearson correlation is a suitable technique in determining the relationship between two variables containing one dependent variable and one independent variable (Cohen, Manion & Morrison, 2007). Pearson is a parametric technique that can be applied when data obtained from the field is assumed normality distribution (Cohen, Manion & Morrison, 2007). The multiple linear regression analysis was conducted in this research to elicit the relationship between attributes of urban green spaces selected in Putrajaya (quality X_1 , quantity X_2 , and accessibility X_3) as independent variables. Health promotion benefits enjoyed while visiting the open spaces as dependent variable Y . Multiple regression analysis helps measure the relationship between one dependent variable (DV) and two or more independent variables (IV's) (Fox, 2015). Kilic (2013) highlighted that multiple regression analysis could also predict the most predicting variable amongst the IVs. To determine the best predictors of health promotion; while visiting open spaces in Putrajaya. Three predictor variables of multiple regression models consisted: quality (x_1), quantity (x_2), and accessibility (x_3) as specified below:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \varepsilon_i \dots\dots\dots \text{Eqn.1}$$

Where: Y_i = health promotion;

X_{1i} = quality of open space;

X_{2i} = quantity of open space;

X_{3i} = accessibility of open space;

ε_i = random error.

The proposed hypothesis test to examine the validity of the model as follows:

$$H_{01}: \beta_0 = \beta_1 = \beta_2 = \beta_3 = 0 \dots\dots\dots \text{Eqn.2}$$

$$H_{11}: \beta_0 \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq 0 \dots\dots\dots \text{Eqn.3}$$

3 Result

Putrajaya Lake (M=8) and Taman Putra Perdana (M=7) scored a high mean score amongst the selected four open spaces (Table 1). The parks have facilities that contain unique attributes that integrate both

blue and green potentials of open space that combined to enhance the quality of the park and attract various visitors. Putrajaya Lake park has the highest mean score (M=8), with the quantity attribute having a three mean score because it is the largest of the four open spaces selected in Putrajaya. The open space contained both blue and green features of landscape facilities with efficient consideration of the principle of landscape architecture that enhances the placement of unity and texture to promote place identity. This unique combination of the attributes attracts a score of 3 points. The quality facilitated the attraction of both local users and international tourists. Despite this advantage of good quality and sufficient size, Putrajaya Lake has its boundary connected to Taman Botani and Taman Putra Perdana and extended to some precincts within Putrajaya City. This comprehensive coverage enables the lake to be well accessible and attracts two mean points in terms of accessibility. The park is located strategically within the heart of Putrajaya, which makes the open space highly accessible from any location in the city, thus, promote visitation.

Table 1
Rating of Selected Open Space attributes in Putrajaya

S/N	Open Space	Attributes Rating			Total
		Quality	Quantity	Accessibility	
1	Putrajaya Lake	3	3	2	8
2	Taman Putra Perdana	3	1	3	7
3	Taman Saujana Hijau	2	1	1	4
4	Taman Botani	3	1	1	5
Content analysis					

Table 2
Reliability of Open space attributes

Open Space Attributes	Number of Items	Cronbach's Alpha
Quality	9	.856
Quantity	5	.835
Accessibility	5	.846
Health Promotion	9	.889

The size of Taman Putra Perdana is about 64 hectares and has a low mean score (M= 1) again in terms of quantity as such is considered to be large enough to accommodate potential users. However, Taman Botani was rated low (M=5) with the highest score in terms of quality and least mean scores in quantity and accessibility. The result is due to its location between Taman Putra Perdana and Putrajaya Lake Park, which serves as both advantage and constraint to the open space. Putrajaya Lake enhances the

quality and retains moisture that ensures the survival of nurseries and other plant species that require sufficient water to survive. The combination of both blue and green attributes has facilitated a high score in terms of the quality of the open space; whereas, the location in-between the two open spaces has constrained its accessibility. One would hardly distinguish between Putra Perdana and Taman Botani.

Meanwhile, there is no clear distinction between the two open spaces, as indicated in figure one. Putrajaya Lake also has limited accessibility to Taman Botani, thus influencing the low ratings in its accessibility. Taman Botani also attracts the lowest mean score ($M=1$) in terms of quantity despite its size amounting to (92 hectares) which is large enough to accommodate both scientific adventurers and recreationists.

Taman Saujana Hijau was rated the least ($M=4$) of the selected open spaces in Putrajaya city. The result is not surprising considering the purpose of its creation; Taman Saujana Hijau is a neighborhood open space, and Taman Botani is a scientific nursery laboratory specifically for research. The size (quantity) and accessibility of Taman Saujana Hijau were rated low ($M=1$), respectively. The terrain is sloppy, making it inaccessible to some users, such as physically challenged persons. The distinctive appearance integrated three culturally distinct pavilions that host English, Chinese and European cuisine. This unique potential attracts many culturally diverse users. This quality has enabled Taman Saujana Hijau to attract a mean score of 2 points in terms of quality.

Pearson product-moment correlation analysis elicited the relationship between the quality of open space and health promotion benefits among the users of the four selected open spaces in Putrajaya. (Table 3), revealing a significant positive and moderate correlation ($r = .388$, $p = .000$) between the quality of open space and its ability to enhance the health status of its users. Similarly, the result also revealed a significant positive and moderate ($r = .367$, $p = .000$) relationship between the quantity of open space in Putrajaya and health promotion. This finding agrees with the results from Jenny *et al.* (2013) that examined the relationship between the percentage of open spaces and restoration from stress. The Pearson correlation shows a negative and low relationship between open spaces and stress restoration ($r = -0.286$, $p < 0.05$). The restoration effect from stressful urban life provided by open space indicated by the negative sign, which showed an absence of stress by urban green space users.

Table 3
Correlation Matrix

Variables	Y			
Y (Health promotion)	1			
(Quality of Open Space)	.388**	1		
(Quantity of Open Space)	.367**	.506**	1	
(Accessibility of Open Spaces)	.327**	.643**	.594**	1
Correlation is significant at the 0.01 level (2-tailed).				

Findings also have shown (Table 3) a significant positive and robust ($r = .506$, $p = .000$) relationship between quantity and quality of open spaces in Putrajaya. Meanwhile, the quality and amount of open spaces are of high importance, as both two attributes contribute towards promoting the visitation of the provided facilities in the urban centers. A well-designed natural setting enhances the metropolitan area's liveability and aesthetic quality. When open spaces are equipped with good quality but in limited supply (quantity), there is a likelihood of congestion which would hamper the vitality of the open spaces; and reduce the services provided to the users. Similarly, when the offered urban green spaces in an area had low quality in terms of, for instance, cleanliness and maintenance, there would be a high likelihood of a reduction in their attractiveness to users (Fernández-Juricic, 2004).

Additionally, studies have revealed a statistically significant moderate and positive relationship ($r = .327$, $p = .000$) between the open spaces accessibility and health promotion of the users in Putrajaya. In this context, accessibility promotes both passive and active users. Inactive users could easily walk around the open spaces to refresh or sit to observe the scenic beauty or actively engage in green exercise, contributing to physical and mental health, which is widely emphasized (Wolch et al., 2014; Schipperijn et al., 2013). Green activities assist positively towards the reduction of obesity and other diseases that are associated with inactivity. The outcome of this study has justified this assertion, relying on the positive correlation between accessibility to open spaces and health promotion. Thus, the relationship is from open spaces' ability to enhance an active lifestyle promoting healthy living.

Table 3 revealed a strong positive and significant ($r = .643$, $p = .000$) relationship between accessibility to open spaces and their quality in Putrajaya. Accessibility itself is a determining factor in rating the quality of open spaces because it indicates the quality of the physical plan of the overall urban area (Kim, Lee, & Klenosky, 2003). Parks also have reputations reflecting their use, repute, upkeep, and design (Byrne & Wolch, 2009). Therefore, it is pertinent to provide accessible open spaces that meet the needs and aspirations of the potential users. Thus, it would reduce the under-utilization of open spaces and provide the anticipated benefits of visiting them.

Similarly, there is a strong positive and significant ($r = .594$, $p = .000$) relationship between accessibility to open spaces in Putrajaya and their subsequent quantity. Quantity and accessibility are essential attributes in bringing urban communities to experience the benefit attached to the supply of adequate open spaces in a metropolitan area. Thus, providing fair and accessible open spaces enhances contact with nature and promotes restorative stress service, as indicated by Ulrich.

3 Predictor Of Health Promotion In Putrajaya Open Spaces

To determine the best set of predictor variables in predicting the health promotion of visitors to open spaces in Putrajaya, entered method of multiple regressions was used (Table 4). As depicted in the coefficient of regression table, the estimates of the model coefficient b_0 are 13.239, b_1 is 0.246, b_2 is 0.373, and b_3 is 0.40. Therefore, the estimated model is as below

Table 4
Coefficient of Multiple Linear Regression Analysis of Open space Attributes and Health Promotion

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	13.239	1.533		17.115	.000
	Quality	.246	.064	.237	4.194	.000
	Quantity	.373	.084	.317	6.628	.000
	Accessibility	.040	.080	.033	.494	.622
a. Dependent Variable: health promotion						

$$Y (\text{health promotion}) = 13.239 + 0.246(X1) + 0.373(X2) + 0.40(X3)$$

The coefficient of determination R-squared of 0.304 implies that the three predictor variables explained about 30% of the variance in health promotion of the visitors to open space in Putrajaya. A parallel objective used in this study has shown that the variables entered into the regression analysis have explained 45% variance in satisfaction while visiting open spaces in Putrajaya. The results demonstrate that the three attributes have explained about 75% variance in satisfaction and health promotion, while only 25% are by other variables (s) not considered in this study. This result illustrated that, whereas there is a significant relationship between open space visitations with health promotion, the result does not indicate with confidence that visiting open spaces may predict health promotion. The result suggests that the provision of open space plays a significant role in enhancing the health status of visitors in Putrajaya. Hence, the researchers deduced that the provision of open space facilitates quick recovery from stress, as indicated by Stigsdotter & Grahn (2011).

The ANOVA result presented in Table 5 revealed that the F-statistics (38.584) is relatively good. Still, the corresponding p-value is highly significant (0.000), lower than the set alpha value of 0.05. The result indicated that the slope of the estimated linear regression model is not equal to zero, confirming a linear relationship between health promotion of open space visitation in Putrajaya and the three explanatory variables.

Table 5
Model Summary of Open space Attributes and Health Promotion

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.551 ^a	.304	.284	2.57955
a. Predictors: (Constant), Accessibility, Quantity, Quality				

Table 6
ANOVA of Multiple Linear Regression Analysis of Open Space Attributes and Health Promotion

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1098.746	3	366.249	38.584	.000 ^b
	Residual	4676.820	365	12.813		
	Total	5775.566	368			
a. Dependent Variable: health Promotion						
b. Predictors: (Constant), accessibility, quantity, quality						

The regression model shows that health promotion would increase on average by 0.246 for every unit increase in the quality of open spaces. The net of the effects changes due to the quantity and accessibility of the open spaces. Health promotion would also increase by 0.373 for every increase of one unit in the quantity of open space supply in Putrajaya. The net of the effects changes due to the quality and accessibility of the open space's supply Putrajaya. Health promotion would increase on average by 0.40 for an increase of one unit of accessibility to open space in Putrajaya net of the effect's changes by quality and quantity of the open space in Putrajaya. The analysis shows that the quality of open spaces has a unique statistically significant contribution to health promotion ($\beta = 0.237$, $t = 4.194$, $p = 0.000$). Also the quantity of open spaces contributes significantly to health promotion ($\beta = 0.317$, $t = 6.697$, $p = 0.000$). While, the accessibility is not statistically significant in promoting the health status of visitors to open spaces in Putrajaya ($\beta = 0.494$, $t = 0.033$, $p = 0.422$).

Based on the analysis of the health promotion model, the quality and quantity of open spaces are statistically significant contributors to health promotion. At the same time, accessibility is not a contributing variable in promoting the health status of urban green space users in Putrajaya. Though, the overall model is a weak contributor in predicting health promotion. Thus, the mathematical derivative of the regression equation for the health promotion model is as follows:

$$Y = 24.143 + (0.246)x_1 + (0.373)x_2 + (0.040)x_3 + \text{Error}$$

Meanwhile, quality is an attribute that enhances the appearance of open spaces and thereby contributes to the greater visitation of the provided facilities. The amount of available open spaces would assist the residents of urban areas choose their most appreciated and desired open space. Similarly, quantities of open spaces promote more significant contact within urban areas and provide sufficient space for various categories of urban green space users. Considering ($R^2 = 0.304$, adjusted $R^2 = 0.284$), visitors can open spaces an opportunity to engage in multiple recreational activities away from their sedentary urban lifestyle (Brown, Faith, & Weber, 2014). open spaces promote social contact among numerous users (McCunn & Gifford, 2014), improving visitors' social well-being and providing restorative services from stressful urban lifestyles (Stigsdotter & Grahn, 2011). According to Richardson *et al.* (2013), a positive

relationship between the greenness of open spaces with a reduced risk of cardiovascular disease when the amount of available space provided ranges from 33.3–69.8%. Thus, individuals residing in a greener environment are less likely to have poor mental health (odds ratio 0.81, at the 95% confidence interval 0.66–1.00; $P = 0.045$) when compared with individuals living in an area with a lesser green environment. Also, Individuals living in a greener environment are more likely to satisfy the recommended physical exercise requirement of 150 minutes per week than individuals living away from a green background (44%, $p = .001$). Other studies' outcomes revealed self-reported health promotion, including relaxation, positive emotions within oneself and the place, and spiritual well-being as users' reasons for visiting open spaces (Irvine *et al.*, 2013). Similarly, Tyrväinen *et al.* (2014) indicated that even short time visitation to open spaces could have a significant positive restorative effect from stress compared to a built environment.

4 Discussion

The correlation analysis shows that the quality of open spaces contributes to health promotion among resident users of open spaces in Putrajaya. However, the correlation indicates a moderate relationship between the quality of open spaces and health promotion; while visiting the designated open areas. It is worthy to note that, quality of open spaces plays a vital role in influencing the attitude of available space users in promoting frequent visitation (Groenewegen *et al.*, 2012). When the quality of open spaces meets the needs of the potential users, this can serve as an enabler to enjoy restorative effect from the stresses of urban life to the serenity and quietness of open spaces (Carrus *et al.*, 2015). The quality of open spaces promotes the use of the facilities therein (Thompson & Aspinall, 2011). Lee & Maheswaran's (2011) work shows that visitation to open spaces is heavily dependent on its quality. Therefore, failure to provide open spaces of good quality would limit their usage. A classic example is in Marzukhi, Karim, & Latfi's (2012) work, which shows that improper management of open spaces can result in their abandonment. Thus, users will be attracted to even far distanced open spaces with required quality for recreational and other benefits.

The presence of adequate open spaces (quantity) would help in reducing the number of time people spend indoors (Coon *et al.*, 2011), and hence can minimize sedentary lifestyle (Dahmann *et al.*, 2010). The presence of sufficient open spaces would aid visitation to such places, either for walking, sports, or leisure and recreation activities and observation of nature (Arnberger & Eder, 2012), which can provide a refreshing effect from the psychological stress associated with open spaces visitation. An increasing number of health hazards are related to people's lifestyle, such as an increasingly sedentary lifestyle, physical inactivity, chronic psychological stress, and a good number of people are staying indoors (Nordh, Grahn, & Währborg, 2009).

Engaging in outdoor physical activity in open spaces (accessibility) satisfy physical activity requirement, as revealed by Dinnie, Brown, & Morris (2013). It is usually regarded as a public asset that urban communities can utilize. Mitchell & Popham (2008) observed that people who have greater exposure to open spaces from their homes (accessibility) are less likely to die from environmental ill health or

circulatory diseases. They showed that income and socio-economic inequalities are not statistically significant. The positive outcome revealed results from a high level of contact to open spaces that facilitated physical activity among the people. Open spaces also provide the urban population with an opportunity to socialize and engage in physical activities and promote place attachment (Kimpton, Wickes, & Corcoran, 2014). A study conducted by Sullivan (2004) investigated the relationship between a neighborhood with open spaces and a barren one. The finding revealed that those urban residents with sufficient open spaces use them more often than their counterparts in empty locations. Thus, social interaction is more frequent than in sterile environments. This finding indicates that urban residents appreciate open spaces, which promote outdoor recreation and promote the health status of urban residents (Rostami et al., 2014).

5 Conclusion

The relationship between optimized urban design and public health has been investigated in this study using reliable statistics. The Pearson moment correlation analysis analyzed the three open space attributes (quality, quantity, and accessibility). The results show a moderate positive relationship with health promotion benefits resulting from open spaces visitation in Putrajaya. The results implied that each of the attributes used in this study has a unique contribution toward influencing visitation to open spaces in Putrajaya. The multiple regression analysis revealed that only two features (quality and quantity) entered into the regression model made a unique statistical contribution to promoting open space visitors' health status in Putrajaya.

Furthermore, accessibility appeared to have a low statistical contribution toward enhancing the health status of open space visitors in this study. The results implied that designing open spaces for recreation, leisure or promoting green exercise promotes health status. Efforts must be on provide open space of high aesthetic quality in sufficient quantity and size, as indicated in this study.

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Availability of data and material (data transparency)

The data used in developing the manuscript is within the text submitted for consideration

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Authors' contributions (optional: please review the submission guidelines from the journal whether statements are mandatory)

All authors presented in the manuscript have contributed to developing the manuscript submitted for consideration to be published

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Consent for publication (include appropriate statements)

All authors consented to publish the submitted article for consideration if accepted.

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Figures

Figure 1

Map of Putrajaya showing the Selected Open Spaces